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[COMMUNICATION]

The Life Span of Wild Populations of the Fish *Oryzias latipes* under Natural Conditions

NOBUO EGAMI, OSAMU TERAO[1], and YASUHIRO IWAO[2]

[2]*Department of Biology, Faculty of Science, Yamaguchi University, Yamaguchi 753,* [1]*Zoological Institute, Faculty of Science, Tokyo University, Tokyo 113, and National Institute for Environmental Studies, Ibaraki 305, Japan*

ABSTRACT— Wild populations of the medaka, *Oryzias latipes*, were collected from irrigation canal or pond near Imbanuma in Chiba Prefecture and irrigation pond in Yamaguchi City at different times of the year. The frequency distribution of the body length of each population was then examined in order to provide information on the breeding season, the rate of growth, and the life span under natural conditions. From the data it is likely that (1) the breeding season of the fish extends from May to August, (2) the fish grow during the spring and summer seasons, and (3) the life span of the wild medaka is normally one year and a few months. It was, however, demonstrated that if yearling fish were transferred to aquaria and kept under favorable conditions, some fish could survive more than two years. From the present results and the life-span data obtained by our previous observations under laboratory conditions, it is concluded that life span of this species is quite different between wild and captivity conditions; the longevity is markedly modified by environmental conditions.

INTRODUCTION

The medaka, *Oryzias latipes* (small freshwater teleost), is native to Japan and its adjacent regions. This species has come to be widely used as a laboratory animal in various fields in biology. Because it is a laboratory animal, the life span of the species under various conditions should be examined. As a part of the examination, the present observation was carried out. Life-span data for the orange red variety of this fish under captivity conditions in laboratory aquaria have been reported; the mean life span is about 1,000 days, and the longest record 1,838 days [1, 2]. On the other hand, according to some observations [3–6], the life span of the wild population of this fish under natural conditions seems to be shorter than under laboratory conditions; therefore, we examined the body length distribution of samples collected randomly from wild populations in various seasons and estimated the life span of the fish from the data. Furthermore, wild fish were transferred to aquaria, and the subsequent survival of the fish was examined.

The results suggest that the life span of this species is quite different between favorable laboratory conditions and natural conditions and that the longevity is modified by environmental conditions. The data will be briefly presented in the present report.

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MATERIALS AND METHODS

Two series of collections were carried out. In the first series, samples were collected from the irrigation canals of rice fields or small ponds near Imbanuma, Chiba Prefecture, by O. Terao. The date of each collection is given in Figures 1 and 2. All fish caught were preserved in 70% ethanol after fixation in formalin, and the standard length of fixed individuals was measured.

In the second series, the sampling was carried out at a small pond in Yamaguchi City, near

Yamaguchi University, by N. Egami and Y. Iwao and their students in 1985. After an examination of the parasites of the fish, the total length of each fish was measured (Fig. 3). Then, some live fish were transferred to cylindrical aquaria 24 cm in diameter in order to observe their mortality. The transferred fish were subjected to disinfection with methylen-blue, kept in well water, placed under natural temperature and daylight conditions, and fed with Tetra-Min food (Tetra Werke, West Germany).

In both series, fish were caught at random by the use of a dip net during the daytime. Since the fish are in the habit of swimming near the surface of the water in schools, frequently several fish were caught at one time. Fish smaller than 10–15 mm in body length could not always be collected by the net. The ecological conditions of the collection field and the stomach contents and gonadal conditions of the fish examined will be reported elsewhere by Terao.

RESULTS AND DISCUSSION

The date of collection, the number of fish examined, and the frequency distribution of the body length of each sample are given in Figures 1, 2 and 3, respectively. Figure 1 shows the results of 1983 and 1984, and Figure 2, those of 1985, in Chiba Prefecture (eastern Japan). Figure 3 shows the results of 1985 in Yamaguchi Prefecture (western Japan). The standard length of the fixed samples was measured in the first series (Figs. 1 and 2), while the total length of the live fish was measured in the second series (Fig. 3).

A perusal of Figures 1, 2 and 3 shows no significant differences in the body size of matured fish between these two series. From Figure 1, the following conclusions may be drawn: (1) The growth of fish during October to March was almost nil, since no significant difference in body-length distribution is observable among the samples collected in October, November, December, January and March. (2) Both the yearling and under-yearling fish grew from spring to summer, since the mean body length of both populations increased. (3) In July, most yearlings disappeared from the population while, on the contrary, a population of

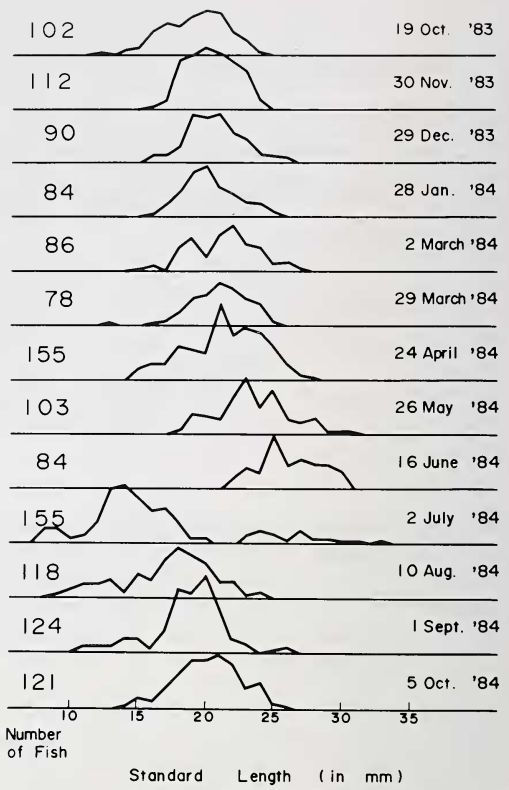

FIG. 1. Frequency distribution of body length of fish caught in 1983 and 1984 in Imbanuma.

small fish (less than 20 mm in standard length) appeared. (4) In August the population of larger fish (yearling fish) completely disappeared, and a growth of the smaller fish (under-yearling fish) took place from July to October. (5) In October and later, the addition of young fish to the population did not occur, since no individuals smaller than 15 mm in standard length were found.

As is shown in Figure 2, a similar, successive change in body length was observed in the 1985 seasons. In 1985, newly hatched young appeared earlier than in 1984, but there were no essential differences in seasonal change in body length distribution between those two years. From these facts, it is evident that the breeding season of this fish is from May to July. A small number of under-yearlings bred in August.

In the Yamaguchi population (Fig. 3), two groups of different sizes are clearly distinguishable in May. It was clear from the observation that the

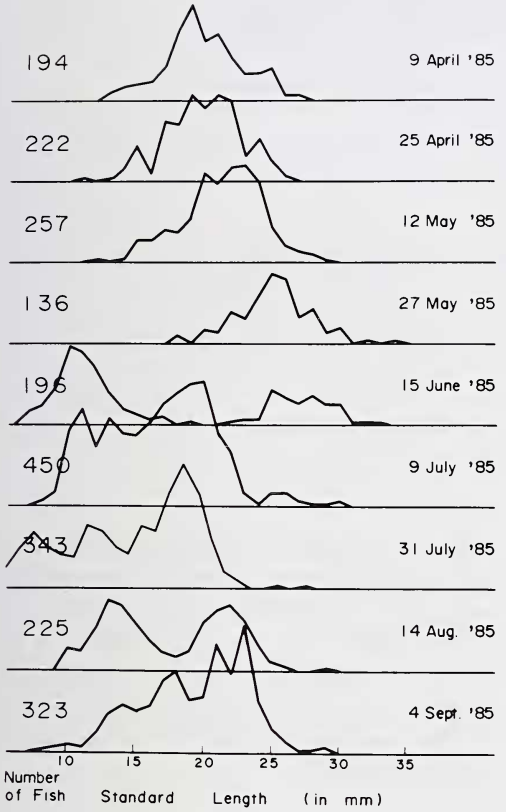

FIG. 2. Frequency distribution of body length of fish caught in 1985 in Imbanuma.

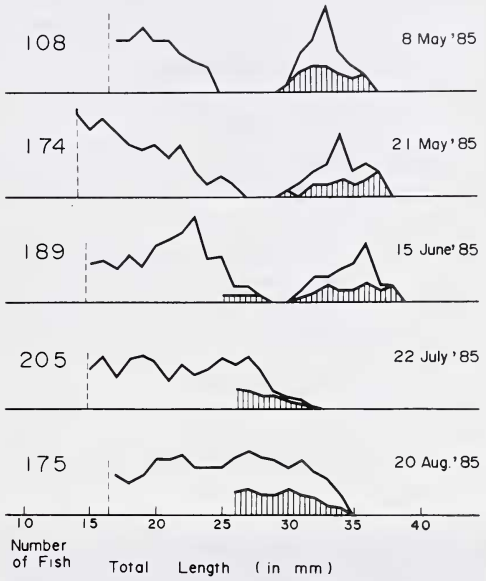

FIG. 3. Frequency distribution of body length of fish caught in 1985 in the irrigation pond in Yamaguchi. Hatched areas show males.

larger fish were yearling males and females, while the smaller ones were newly hatched young. The male secondary sexual characteristics had not developed in the under-yearling fish in May, but they became clearly observable in June in some large individuals. In July the under-yearling fish grew rapidly and bred, while the yearling fish disappeared.

It is clear from these data that the succession of generations took place earlier in Yamaguchi than in Chiba and that the breeding season is from April to August.

A perusal of Figures 1, 2 and 3 will show (1) that the breeding season of the fish extends from April-May to August, (2) that the fish grow during the spring and summer seasons, (3) that the yearling fish and the under-yearling fish are distinguishable by their body length, and (4) that the yearling fish are not able to survive until the end of summer. Therefore, the life span of the wild fish is one year and a few months. In other words, the maximum life span under natural conditions is shorter than one and a half years.

Kamito [5], Kubo and Sakurai [3], and Awaji and Hanyu [4] have reported on the life cycle of this species on the basis of natural observation or the annual change in body size. As to the life cycle of wild fish, the present data are in agreement with their reports in important points.

It was observed in the Yamaguchi populations that the majority of the yearling adults were slim in shape and that most yearling fish were infected with carp-lice (*Argulus japonicus*) or *Lernaea cyprinasea* (Table 1).

In order to establish the probable cause of death under natural conditions, on May 21 and June 15, 1985, 15 and 10 yearling fish respectively were placed in cylindrical aquaria after the parasites had been removed. Some fish died within a week after the transfer; however, those fish which did not die soon could survive for a long time. On September 18, more than a half of the fish still survived (Table 2); these survivors were plump and healthy in appearance. Six survivors on September 18 (from

Table 1. Number of fish infected with *Argulus* and *Lernaea*

Date of examination	Number of fish examined	
	Total	Infected
May 8, 1985	40	28
June 15, 1985	48	35

Table 2. Number of fish transferred to aquaria and survivors

Date of transfer	Number of fish transferred	Number of survivors	
		Sept. 18, 1985	Sept. 30, 1986
May 21, 1985	15	8	–
June 15, 1985	10	6	2

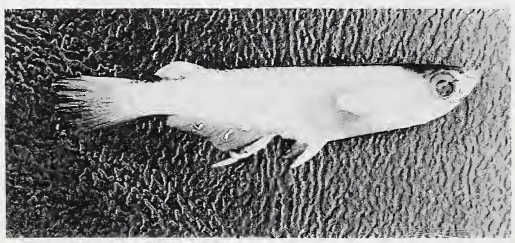

Fig. 4. Example of fish infected with *Lernaea*. Besides a large parasite, small parasites are observable on the anal fins.

among those caught on June 15) were continuously kept in captivity, and two of them survived until the end of September, 1986 (Table 2). From these facts, it seems highly probable that the fish have the ability to survive more than two and a half years if kept under favorable conditions, but they die of environmental factors (such as infection, unsufficiency of food, or being caught by a natural enemy), not of any intrinsic cause, under severe wild conditions.

We have already reported that the mean life span of *Oryzias latipes* under captivity conditions is about 1,000 days, the longest life span being 1,838 days. The present results show that, under natural wild conditions, the longest life span is less than 1.5 years. It is highly probable that the main cause of death under natural conditions is one ecological factor or other and that the ecological life-span and the physiological one are quite different in this species. We must keep in mind, when using this material as a model animal in biology, that the ecological and physiological life spans of this fish are quite different.

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